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AN UNUSUAL SQUID PARALARVA (CEPHALOPODA) WITH TENTACULAR PHOTOPHORES

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Abstract.—We describe an unusual squid paralarva from the eastern North Pacific. This paralarva has characters indicating it might be a gonatid, but if so it is the first gonatid species known to have photophores on its tentacles. Structures that might be photophores were also located on the interior of the mantle. One other gonatid species, *Gonatus pyros,* is known to have photophores but these are located only on the eyes. *Gonatus pyros* spawns in the eastern North Pacific, and its early paralarva has not been described. We therefore tested the hypothesis that our squid may be an ontogenetic stage of *G. pyros.* Tentacles of young *G. pyros* were examined histologically to see if photophore tissue might be embedded in the tentacles, but the results were inconclusive. We also examined early stages of eight other gonatid species. None of these had either tentacular or internal photophores. We therefore describe this very unusual specimen, but its identity remains uncertain.

During examination of a collection of cephalopods from the eastern North Pacific we found a paralarva with characters of the squid family Gonatidae, but also with what appeared to be a single photophore on each tentacle and two more photophores on the interior wall of the mantle just anterior to the bases of the fins. Only one gonatid species, *Gonatus pyros* Young, 1972, is known to possess photophores, and in that species a large photophore is located on the ventral surface of each eye (Young 1972). The presence of photophores in locations other than the eyes on this paralarva is therefore noteworthy.

Few small gonatid paralarvae (<10 mm mantle length, ML) have been described, and little is known about them. Kubodera & Jefferts (1984), in a study of distribution and abundance of the early life stages of North Pacific squids, found only three *Gonatus pyros* specimens <10 mm ML. Because *G. pyros* was omitted from descriptions and keys to early paralarvae <10 mm ML by Kubodera & Okutani (1981) and Okutani & Clarke (1992), we hypothesized that our specimen may be an early stage of that species. If *G. pyros* were shown histologically to have photophore tissue embedded in its tentacles then we could argue that *G. pyros* does develop tentacular photophores early in life and that our specimen could be that species.

Materials and Methods

The specimen (USNM 817795; ca. 5 mm ML) was collected in the eastern North Pacific, off southern California at 34°N, 121°W on 13 November 1969. Sampling time was 1730–1800 and depth was approximately 215 m.

We examined the possibility that the specimen was a *Gonatus pyros* because this is the only photophore-bearing gonatid known, and it is found in abundance in the sampled area (Kubodera & Okutani 1981). Examination of gross tentacular morphology of the smallest *G. pyros* specimens in the collections of the National Museum of Natural History revealed no photophores but a damaged area was consistently found

at approximately the same location as the photophores on our paralarva. The tentacles of three *G. pyros,* (USNM 727486, ML 32 mm, 17 mm, and 16 mm) were examined histologically for embedded photophores. These specimens had been fixed in formalin and preserved in 45% isopropanol. Histological preparation included ethanol dehydration, tissue embedding in paraffin, and frontal sectioning at 6 μm thickness. Hematoxylin and eosin stains were used and the sections were examined using light microscopy. Other gonatids from the National Museum of Natural History were examined for the presence of photophores. These were the smallest specimens in the collection for each species listed below and included: *Berryteuthis anonychus* (USNM 575631, ML 68 mm), *Gonatopsis borealis* (USNM 813458, ML 33 mm and 28 mm), *Gonatus onyx* (USNM 730044, ML 30 mm and USNM 730043, ML 17 mm), *Gonatus madokai* (USNM 884252, ML 15 mm and 15 mm), *Gonatus fabricii* (USNM 884254, ML 18 mm and 19 mm), *Gonatus berryi* (USNM 729867, ML 12 mm and 12 mm), *Berryteuthis magister* (USNM 814633, ML 17 mm and 21 mm), *Gonatus antarcticus* (USNM 884253, ML 42 mm).

Results

The specimen was identified to the family Gonatidae using a paralarval key to the cephalopod families (Sweeney et al. 1992). Identification was based on the following characters: arms with four rows of suckers, robust tentacles with minute suckers along most of the tentacular stalk and distinctive tentacular clubs developing >4 rows of minute suckers.

General morphology (Fig. 1).—Mantle: Inverted but bell-shaped, thin, muscular; fins small, membranous; Mantle Width estimated to be ca. 60% Mantle Length (ML). Funnel-locking cartilage straight. Two small spheres, possibly photophores, located on interior wall of mantle just anterior to bases

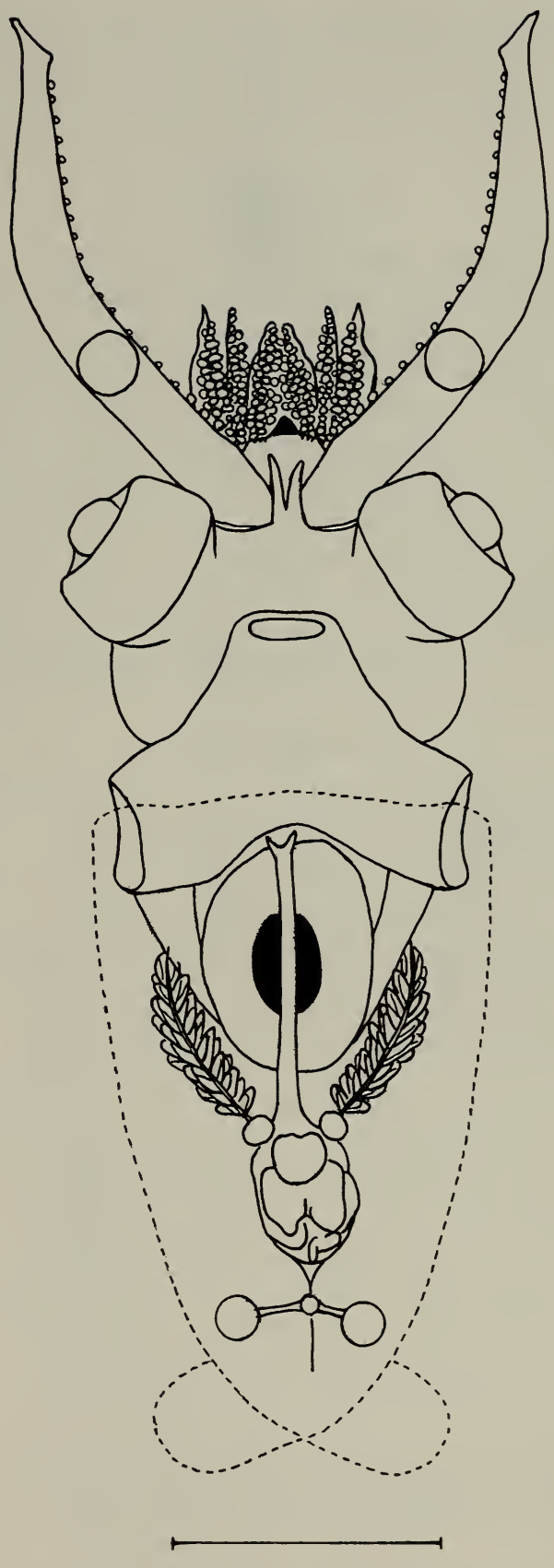

Fig. 1. Ventral view of gonatid paralarva. Mantle shape estimated from inverted mantle. Scale bar = 2 mm.

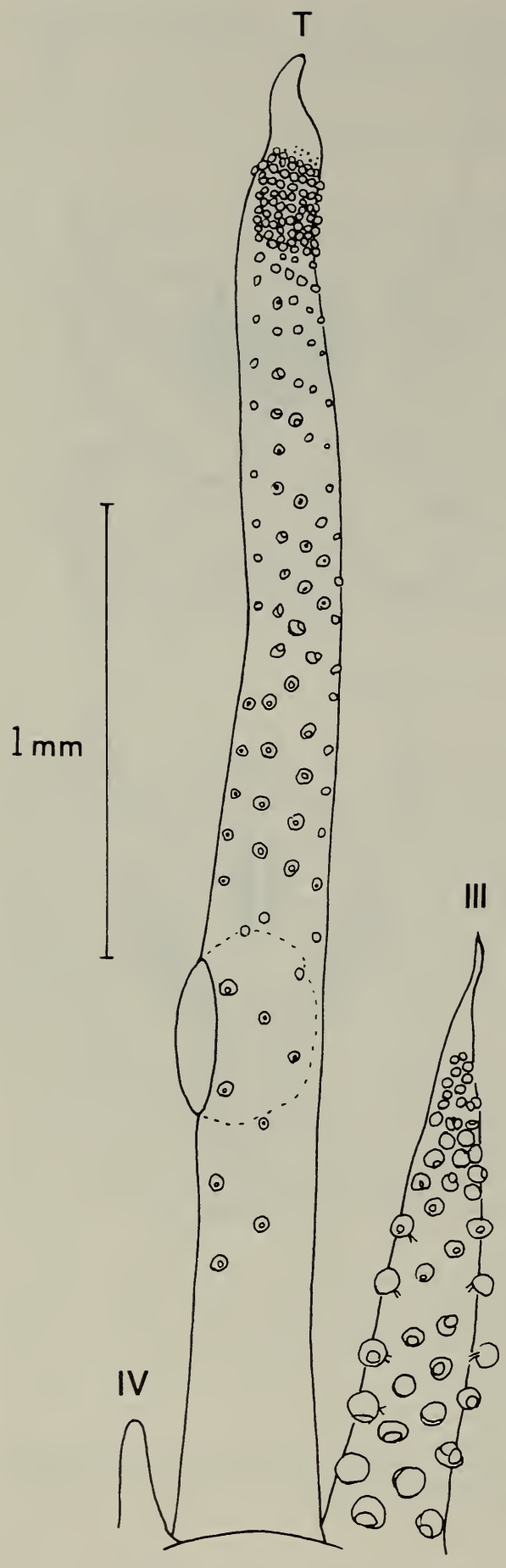

Fig. 2. Ventral view of (left to right) arm IV, tentacle, and arm III on right side. Scale bar = 1 mm.

of the fins, connected to a smaller centrally located sphere.

Head: Squarish in shape, slightly narrower than mantle opening; large anterolateral eyes. No photophore anlagen on ventral surface of eyes.

Arms: Stout, muscular. Arm formula I=II=III≫IV. Suckers tetraserial on arms I, II and III. No suckers on arms IV.

Tentacles (Fig. 2): Stout, muscular, ca. four times longer than longest arms, about 3.5 mm long; smaller suckers cover most of oral surface of stalk, in two staggered rows proximally, increasing to five rows on distal stalk; club developing on distal ⅛ with numerous minute suckers in seven rows. Large photophore on aboral surface ca. ⅖ of tentacle length from base. Photophore diameter about equal to tentacle diameter. Photophore round and distinctly darker in shade than tentacle. Photophore roughly spherical and partially embedded in tentacular muscle.

Digestive gland: Oblong with ink sac embedded in ventral surface.

When the specimen was stained with Methylene Blue, all tissues stained except the structures we presume to be photophores. Histological examination of *G. pyros* tentacles failed to reveal photophore tissue. No photophores, either tentacular or internal, were found on any of the other gonatids examined. Photophores on the paralarva were not sectioned because of the uniqueness of the specimen.

Discussion

The specimen has familial characters to classify it as a probable gonatid squid. These characters include: arms with four rows of suckers, straight funnel-locking cartilage and tentacular clubs with >4 rows of minute suckers. Other squid families have species with tentacular and/or internal photophores. The Lycoteuthidae have both. But no family other than Gonatidae is known to have the sucker patterns of this specimen.

Its size of 5 mm ML places it in the size range least known for gonatids. The presence of tentacular (and perhaps internal) photophores, however, is without precedence in the family.

Gonatus pyros is the only species in the family Gonatidae that has been described to have photophores. The photophores of *G. pyros* are, however, in a different location than the ones on our specimen. *Gonatus pyros* has a large oval photophore on the ventral surface of each eye (Young 1972) whereas our gonatid paralarva lacks ocular photophores, but has one large round photophore on the aboral surface of each tentacular stalk and possibly a complex of photophores in the posterior mantle cavity. The location where the specimen was collected is in the general region where larger paralarvae of *G. pyros* have been found (Kubodera & Jefferts 1984). *Gonatus pyros* specimens >10 mm ML were found to be frequent and abundant off the Oregon and Washington coasts between 40–50°N and 140–120°W (Kubodera & Jefferts 1984).

Our histological examination was inconclusive. Our inability to locate photophore tissue does not mean that it was not there at an earlier stage. Absorption of paralarval photophores has been suspected in the ommastrephid squid *Doscidicus gigas* (C. F. C. Roper, pers. comm.). The gonatid photophore tissue could have been completely resorbed by 16 mm ML. If so, this could explain the apparent weak spot in the tentacles of the small *G. pyros* we examined. In other words, we failed to support the hypothesis that our paralarva is an early stage of *G. pyros* but we do not feel that it has been refuted conclusively. Because the histological examination of *G. pyros* failed to indicate embedded or resorbed photophores, we have no evidence that our paralarva is that species. Examination of other gonatid species did not reveal any characters to link our paralarva with any of those species. However, the squid treated in this paper, although unidentified, remains noteworthy in that it appears to be a gonatid squid with photophores on the tentacles.

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